Evaluating and improving the accuracy of 3D models from UAS imagery

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I. Introduction

Aerial images taken by an Unmanned Aircraft System (UAS) are used to generate large georeferenced overviews of a terrain. In addition, structure from motion algorithms have enabled the creation of three dimensional (3D) digital terrain models of this terrain [1]. As applications using these 3D models become more demanding, the accuracy requirements grow. In our work we evaluate the real world accuracy of state of the art 3D reconstruction methods and propose a system to improve the results.

II. Measuring the accuracy

After creating a 3D model using the methods from [1] and [2] we measure the correctness of the resulting 3D points by comparing them with ground truth. This ground truth is acquired by placing cross shaped markers on the terrain and measuring their position using surveyor equipment. Evaluating the model like this we obtain an error of up to 5 meter in all directions, mainly caused by the low quality GPS onboard the UAS.

III. Improving the accuracy

We improve the global accuracy by including some of the ground truth into the computations. Our experiments show that a very limited amount of points suffices to achieve much better results. This is shown in figure 1, where markers 4, 7, 12 and 14 were used as ground truth. The computed position of the other markers is now within 20 centimeter of their actual position. This is close to the error produced by the surveyor equipment, of about 10 cm.

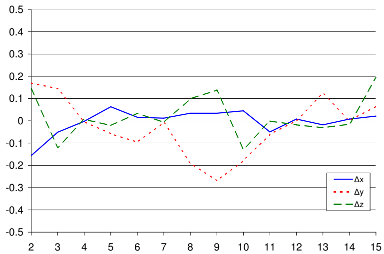

Figure 1. The difference in meter between measured and computed marker positions.

IV. Conclusions

We have shown that by including a limited amount of ground control points in the 3D reconstruction of a terrain, an accuracy of 10 to 20 cm in all directions can be achieved. This implies that ground based surveying is still required, but only at a fraction of the time and cost when no UAS would be used.

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References

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